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VI. *A Letter to the Learned Dr. Caleb Cotesworth, F. R. S. of the College of Physicians, London, and Physician to St. Thomas's Hospital; containing a Comparison between the Danger of the Natural Small Pox, and of that given by Inoculation. By James Jurin, M. D. R. S. Secret.*

S I R,

THE sincere and disinterested Regard for the Good of Mankind, which you have always manifested, as well in your extensive private Practice, as in that publick Post, which you have so long and so usefully fill'd, must affect you, I am sure, with a great and sensible Concern for the Destruction made among us by that terrible Calamity the Small Pox. We have seen, for some considerable Time past, above 100 Persons *per Week* in this City and Suburbs, taking one Week with another, to be carry'd off by this Disease; a Consideration certainly that ought to dispose us to enter into any Measures, by which we may reasonably hope to put some Stop to the Progress of so cruel a Distemper.

To this Purpose, Sir, the Method of Inoculation, which has lately been introduced among us, is strongly recommended on the one hand, and has been opposed with a great deal of Warmth and Zeal on the other.

I have no Inclination to enter into this Controversy ; it is in better and abler Hands : but, as the Point in Dispute is of the utmost Importance to Mankind, I heartily wish, that, without Passion, Prejudice, or private Views, it may be fairly and maturely examin'd. In order to which, if the following Extracts and Computations, concerning the comparative Danger of the Inoculated and Natural Small Pox, may be of any Use to your self, or to other impartial and disinterested Judges, I shall think my Labour well bestowed.

The Number of Persons, who have had the Small Pox by Inoculation here in *England*, is, by the best Information I have been able to collect, as follows.

**Inoculated by**

Dr. Nettleton	- - - - -	61
<i>Claudius Amyand</i> , Esq; Serjeant Surgeon	-	17
Mr. Maitland, Surgeon	- - - - -	57
Dr. Dover	- - - - -	4
Mr. Weymish, Surgeon	- - - - -	3
The Reverend Mr. Johnson	- - - - -	3
Dr. Brady, at <i>Portsmouth</i>	- - - - -	4
Mr. Smith, Surgeon, and Mr. Dymer, Apothecary, at <i>Chichester</i>	- - - - -	13
Mr. Waller, Apothecary at <i>Gosport</i>	- - - - -	3
A Woman at <i>Leicester</i>	- - - - -	8
Dr. Williams at <i>Haverford West</i>	- - - - -	6
Two other Persons near the same Place	- - - - -	2
Dr. French, at <i>Bristol</i>	- - - - -	1
In all —		182

Out of this Number the Opposers of Inoculation affirm, that two Persons died of the Inoculated Small Pox ; the Favourers of this Practice maintain, that their Death was occasioned by other Causes. If, to avoid dispute,

dispute, these two be allow'd to have died of Inoculation, we must estimate the hazard of dying of the Inoculated Small Pox, as far as can be collected from our own Experience, to be that of 2 out of 182, or one out of 91.

The Reverend Mr. *Mather*, in a Letter dated *March 10. 1721.* from *Boston in New England*, gives an Account, That of near 300 inoculated there, 5 or 6 died upon it or after it, but from other Diseases and Accidents, chiefly from having taken the Infection in the common way by Inspiration, before it could be given them in this way of Transplantation.

If, as we have done before, to avoid all occasion of dispute, we allow 5 out of these 300 to have died of the Small Pox by Inoculation, notwithstanding what Mr. *Mather* has said of their dying by other Accidents or Diseases ; the hazard of Inoculation will thence be determin'd to be that of 1 in about 60. But here it must be observ'd, that by all the Accounts from *New England*, the Operators there appear not to have been so cautious in the choice of their Subjects, as here in *England*. For Mr. *Mather* tells us, that the Persons inoculated were *young and old, from 1 Year to 70, weak and strong*; and by other relations we are inform'd, that *Women with Child, and others even in Childbed*, underwent the Operation. Apparently the Greatness of the Danger they were in, from the Infection in the natural Way, which then raged among them with the utmost Fury, made them the more adventurous.

We come now, Sir, to the second Part of our Design, which is to form an Estimate of the Hazard, which all Mankind, one with another, are under of dying of the natural Small Pox, that, by comparing this with the Hazard of Inoculation, the Publick may

be enabled to form a Judgment, whether or no the Practice of Inoculation tends to the Preservation of Mankind, by lessening the Danger to which they are otherwise liable.

With this View I have consulted the Yearly Bills of Mortality, as far back as the Year 1667, being the Year after the Plague and the Fire of *London*, comprehending to the present Time the Space of 56 Years, from 42 of which I have given Extracts in the two following Tables.

The first of these takes in the first 20 Years, distinguishing for every Year the total Number of Burials, and likewise the Number that died of the Small Pox, in two separate Columns. The third Column shews, how many died of the Small Pox out of every Thousand that were buried ; and the fourth Column represents the Proportion between those that died of the Small Pox, and the whole Number of Burials, by the nearest Vulgar Fraction, having always 1 for the Numerator.

The second Table gives the last 22 Years, after the same manner, and at the bottom of each Table is given the Total Number for each Series of Years, and likewise the Number that died each Year, taken at a Medium, one Year with another : by which it appears, that the Proportion between the Number of those that die of the Small Pox, and the whole Number of Burials, is very nearly the same, upon an Average for each Series of Years.

The 14 intermediate Years between 1686 and 1701 are left out, because in the Bills for those Years, the Accounts of the Small Pox and Measles are not distinguished, as in the preceding and following Years, but are join'd together in one Article, so that from them no certain Account can be drawn of the Number of Persons, that died of the Small Pox.

T A B L E I.

Years	Total No of Burials	Died of the Small Pox.		
		In all.	In 1000	In Proportion.
1667	15842	1196	75	$\frac{5}{232}$
1668	17278	1987	115	$\frac{1}{15}$
1669	19432	951	49	$\frac{1}{39}$
1670	20198	1465	73	$\frac{1}{27}$
1671	15729	696	44	$\frac{1}{36}$
1672	18230	1116	61	$\frac{1}{30}$
1673	17504	853	49	$\frac{1}{36}$
1674	21201	2507	118	$\frac{1}{18}$
1675	17244	997	58	$\frac{1}{30}$
1676	18732	359	19	$\frac{1}{96}$
1677	19067	1678	88	$\frac{1}{22}$
1678	20678	1798	87	$\frac{1}{24}$
1679	21730	1967	91	$\frac{1}{23}$
1680	21053	689	33	$\frac{1}{64}$
1681	23971	2982	125	$\frac{1}{19}$
1682	20691	1408	68	$\frac{1}{30}$
1683	20587	2096	102	$\frac{1}{20}$
1684	23202	156	7	$\frac{1}{336}$
1685	23222	2496	107	$\frac{1}{22}$
1686	22609	1062	47	$\frac{1}{47}$
20 Years	398200	28459	$71\frac{1}{2}$	$\frac{1}{54}$
Each Year at a Medium	19910	1423	$71\frac{1}{2}$	$\frac{1}{14}$

T A B L E II.

Years	Total N <sup>o</sup> of Burials	Died of the Small Pox.		
		In all.	In 1000	In Proportion.
1701	20471	1095	53	$\frac{1}{19}$
1702	19481	311	16	$\frac{1}{33}$
1703	20720	898	43	$\frac{1}{24}$
1704	22684	1501	66	$\frac{1}{35}$
1705	22097	1095	50	$\frac{1}{21}$
1706	19847	721	36	$\frac{1}{28}$
1707	21600	1078	50	$\frac{1}{20}$
1708	21291	1687	79	$\frac{1}{23}$
1709	21800	1024	47	$\frac{1}{22}$
1710	24620	3138	127	$\frac{1}{19}$
1711	19833	915	46	$\frac{1}{22}$
1712	21198	1943	92	$\frac{1}{22}$
1713	21057	1614	77	$\frac{1}{27}$
1714	26569	2810	106	$\frac{1}{24}$
1715	22232	1057	48	$\frac{1}{45}$
1716	24436	2427	99	$\frac{1}{25}$
1717	23446	2211	94	$\frac{1}{25}$
1718	26523	1884	71	$\frac{1}{37}$
1719	28347	3229	114	$\frac{1}{25}$
1720	25454	1440	57	$\frac{1}{44}$
1721	26142	2375	91	$\frac{1}{28}$
1722	25750	2167	84	$\frac{1}{31}$
22 Years		505598	36620	$\frac{1}{14}$
Each Year at a Medium.		22982	1665	$\frac{1}{14}$
42 Years		903798	65079	$\frac{1}{14}$
Each Year in 42 at a Medium.		21519	1550	$\frac{1}{14}$

By these Tables it appears, that *upwards of seven per Cent. or somewhat more than a fourteenth part of Mankind, die of the Small Pox*; and consequently the hazard of dying of that Distemper, to every individual born into the World, is at least that of one in fourteen. And that this Hazard encreases after the Birth, as the Child advances in Age, will appear from what follows.

From this Estimate it is demonstrable, that, in the Case of Persons actually having the Small Pox, the Hazard that they run, one with another, of dying of that Distemper, is greater than that of one in fourteen; or, which is the same thing, *there must be fewer than thirteen, that recover, for one that dies of the Small Pox*. For since one fourteenth part of Mankind die of the Small Pox, and the other thirteen parts die of other Diseases; if these thirteen have all had the Small Pox, and recover'd from it, before they fell ill of those other Diseases of which they died, then just thirteen will have recover'd from the Small Pox, for one that dies of that Distemper: but, as it is notorious, that great Numbers, especially of young Children, die of other Diseases, without ever having the Small Pox, it is plain, that fewer than thirteen must recover from this Distemper, for one that dies of it.

To determine exactly how many of these thirteen Parts of Mankind, die without having the Small Pox, is a very difficult Task: but it is easy to see, that a considerable Deduction is to be made from them.

In the first place, the two Articles of *Stillborn* and *Abortive Children*, which are put into the yearly Bills, as part of the Number of Burials, are unquestionably to be deducted.

With these two, Sir, you will not I believe, think it unreasonable to join the following Heads, which, by the best Information I can procure, comprehend only very young Children, or at most not above one or two Years of Age: *Overlaid, Chrysoms and Infants, Convulsions, Horseshoehead, Headmoldshot, Teeth, Water in the Head, Worms, Rickets, Livergrown, Chin-Cough, and Hooping-Cough*, which Articles in the Yearly Bills for 22 Years last past, amount at a Medium to 386 in each 1000, of the whole Number of Burials.

It is true indeed, that, in all Probability, some small part of these must have gone thro' the Small Pox, and therefore ought not to be deducted out of the Account: but then, on the other hand, as it is certain, that of the remaining  $\frac{614}{1000}$  of Mankind, that are above

one or two Years of Age, there are great Numbers, that never have the Small Pox, it will I presume be judged to be no unequal Supposition, if I suppose all that are contain'd under the Heads abovemention'd, to have miss'd that Distemper, when by way of Compensation, I allow all the remainder of Mankind to undergo it; which Concession is so large, that it will abundantly make up for what I assume too much in the former Supposition.

Allowing therefore, that out of every 1000 Children that are born, 386 die under one or two Years of Age, without having the Small Pox, and 72 do some time or other die of that Distemper; it follows, that the Hazard of dying of it, to the remainder of Mankind, above one or two Years of Age, who are all supposed to undergo that Disease sooner or later, is that of 72 out of 614, or nearly 2 out of 17: to that

*no more, than between 7 and 8, can recover from that Distemper, for one that dies of it.* And if any considerable part of the aforesaid remainder of Mankind, more than is allow'd for above, do escape having the Small Pox, then the Proportion of those that recover from it, will be still smaller.

This Consideration shews the Fallacy of one plausible Argument, that has been often made use of on occasion of the present Disputes about Inoculation : Which is, that whatever be the Danger of dying of the Small Pox, to those that actually have that Disease, yet, as great Numbers of Persons never have the Small Pox at all, this Danger is what any particular Person may never be in ; and therefore it will be Madness to undergo the hazard of Inoculation, be it great or small, in order to prevent a Disease, which possibly may never befall one.

For if two parts in seventeen of all Mankind, that are above one or two Years of Age, must sooner or later die of the Small Pox, it is plain, that how many parts soever of these seventeen are supposed to escape that Distemper, the Mortality among the remainder, who undergo it, must in proportion be so much the greater. As for instance, if 7 parts escape having the Small Pox, and 10 undergo it, then 2 out of 10, or 1 out of 5, that have the Small Pox, must die of that Disease.

And as it can never be known, whether or no any particular Person be one of those, that are to have the Small Pox ; his Hazard of dying of that Distemper, being made up of the Hazard of having it, and the Hazard of dying of it, if he has it, will be exactly the same, namely, that of 2 in 17, or 1 in 8 or 9, whether the proportion of Mankind, that escape having the Small Pox, be great or small.

But as what has been said concerning the Hazard of the natural Small Pox, is taken from an Account of 42 Years; whereas the Hazard of Inoculation is estimated only from what has happen'd in the space of about 18 Months, since which time it had its first Rise among us; it will perhaps be asked by some Persons, why we do not likewise make the Estimate of the hazard of the natural Small Pox, from the last two Years alone, without running back into so great a number of Years, before Inoculation was begun?

To which we answer, that the Proportion of those that die of the Small Pox, varies so much in different Years, as appears from the Tables above, that it was impossible to come at any Certainty in this point, from the consideration of the two last Years alone: and if any one suspects us of Partiality in proceeding after the manner we have done, he need only cast his Eyes upon the second Table, where he will find, that the Mortality of the natural Small Pox, for the two last Years, has considerably exceeded the Medium we have determin'd, from taking in two and fourty Years.

There is another Method, which, if it were put in practice in several large Towns, or Parishes, and for a sufficient Number of Years, would enable us to come at a nearer and still more certain Computation of the Proportion between those that recover, and those that die of the Small Pox: which is, to send a careful Person once a Year, from house to house, to enquire what Persons have had the Small Pox, and how many have died of it, in the preceding Year. This has been done by Dr. Nettleton the last Year, at several Towns in *Yorkshire*, &c. and the same was done at *Chichester* for the same Year, to the 15th of *October* last, by a Person of Credit, whose Account was communicated to me by my learned and ingenious Friend, Dr. *Whitaker*. Such

Such another Account has been transmitted to me from *Haverford West*, in *South Wales*, by the Learned Dr. *Perrot Williams*, Physician in that Place. The Sum of these Accounts is as follows.

	Sick of the Small Pox.	Died.
Several Towns in <i>Yorkshire</i>	3405	636
<i>Chichester</i>	994	168
<i>Haverford West</i>	227	52
<b>Total</b>	<b>4626</b>	<b>856</b>

From which it appears, that, upon a *Medium* between these Accounts, there *died of the Small Pox almost 19 per Cent.* or *nearly one in five*, of Persons of all Ages, that underwent that Distemper. Which is the more to be remarked, for that *out of 82 Persons*, that had the Small Pox by Inoculation, the same Year, and in the Neighbourhood of the same Places, *not one miscarry'd*.

Mr. *Mather* observes, in his Letter mention'd above, that *out of more than 5000 Persons that had the Small Pox at Boston in New England, within little more than half a Year, near 900 died*, which is more than one in six; and this Account added to those from *Yorkshire, Chichester, and Wales*, reduces the Proportion of those that die of the Small Pox to somewhat more than *18 per Cent.* so that the Hazard of dying of that Distemper, to those who are taken ill of it, is that of *one in between five and six*, or something above *two in eleven*.

The Result therefore, Sir, of these Computations is, that, if the same Proportions should still continue, as have hitherto been determin'd by Observation, we must expect,

That of all the Children that are born, there will, some time or other, die of the Small Pox, *one in fourteen.*

That of Persons of all Ages taken ill of the natural Small Pox, there will die of that Distemper, *one in five or six, or two in eleven.*

That of Persons of all Ages inoculated, without regard to the Healthiness or Unhealthiness of the Subject, as was practised in *New England*, there will die *one in sixty.*

That of Persons inoculated with the same Caution in the choice of the Subjects, as has been used by the several Operators one with another, here in *England*, (if we allow in the two disputed Cases abovemention'd, that the Persons died of the inoculated Small Pox) there will die *one in ninety one.*

But if those two Persons be allowed to have died of other Accidents or Diseases, then we shall have reason to think, as far as any Judgement can be made from our own Experience here in *England*, that *none at all* will die of Inoculation, provided that proper Caution be used; as we are inform'd, on all hands, is the Case in *Turkey*: where *out of many thousands*, that, in the space of about forty Years past, have been inoculated in and about *Constantinople*, by one *Greek Woman*, who still continues that Practice, notwithstanding her extreme old Age, *not so much as one Person has miscarried*, as I am assured by the ingenious Dr. *le Duc*, a Native of *Constantinople*, who was himself inoculated there under the Care of his Father, an eminent Physician in that City.

*I am, &c.*

*James Jurin.*

## POSTSCRIPT.

SINCE this Paper was drawn up and communicated to the Royal Society, the following Account of the Success of Inoculation in and about *Boston*, in *New England*, was procured at my Desire, by my Ingenious Friend Dr. *Nesbitt*, from Capt. *John Osborne*, who resided in that Town and Neighbourhood during the whole time of that Practice. I think proper to insert it here, as it confirms the Extract given above from Mr. *Mather's* Relation, and is a more particular Account of the Matter of Fact, than any that I have yet seen.

In *May*, 1721. the Small Pox was, by the Providence of God, brought into the Town of *Boston*; in *June* it began to spread pretty much, and in the Month of *July* it was got into most parts of the Town, and a considerable Number of People died of it. At this time Inoculation was first put in practice by Dr. *Boyleston*, who then perform'd it upon his own Child and a Negro-Servant, who both did well; notwithstanding which, this Attempt gave great Uneasiness to the Neighbours. However the Practice went on, to the Number of about 40 Persons, one of which was a Woman \* of about 40 or 45 Years of Age, who got well over the Small Pox, as her Husband publickly declared, but had been before troubled with Hysteric Fits, of which she died some little time after. When about 70 Persons had passed under the Operation, myself and Wife, who had hitherto been at a Place called *Roxbury*, a Mile from *Boston*, went into

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\* *Mrs. Dixwell*,

Town and received the Small Pox by Inoculation. We had it with all the Gentleneſs and Moderation that was poſſible, neither of us having an hundred Puſtules, or being ſenſible of any Fever worth mentioning; ſo that we did not find it neceſſary to keep our Beds for it.

In *August* the Small Pox in the natural Way proved more mortal, and Inoculation made a greater Progreſs, the People continuing to come into the Practice of it. A ſecond Person that died after Inoculation, was an Apothecary's Houſekeeper, that was out of Town, till an *Indian* Maid got the Distemper in the ſame Houſe, and remov'd, and died. Upon which this Woman coming to Town, her Master undertook to perform the Operation upon her, which by the Way was the firſt and laſt that he ever perform'd; and on the third Day after the Inoculation, the Small Pox came out upon her very full; from which it was plain, that ſhe had taken the Infection before, in the common way.

The third Person that died after being inoculated, was a † Gentleman, that lodged in the ſame Houſe with my Wife and ſelf at *Roxbury*, who was under great and extreme Infirmitiy of Body, as myſelf was Witneſs, that we fear'd he would have lived but a ſhort time under it. His Friends much perſuaded him to make uſe of Inoculation, believing that it would have carry'd off his Illneſs; but when he made the Experimenter, he had not Strength to go thro' with it. He was about 45 Years of Age, and by the way was a Gentleman of great Worth and Piety.

His Sister † was the fourth Perfon that died upon this Operation. She was about fourty Years of Age,

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† John White, Esq;

‡ Mrs. Wells.

of great Indisposition of Body, and weak, as was her Brother.

The fifth, that died upon Inoculation, was a Woman Servant in a House, where the whole Family, to the number of eight, were inoculated at the same time. She lay in a cold upper Room during her Illness, and was much neglected, the whole Family being down together, so that she died merely for want of a little Attendance. This was in the Town of *Roxbury*, where observe, that 13 Men, Masters of Families, got the Small Pox, and all died; which inclined the People to make use of Inoculation, having before been much against it, and there were 43 Men inoculated there, who all did well. The \* Minister of the Town was the first, that put it in Practice there, much against the Mind of his People at first, though afterwards they were very well pleas'd with it, seeing with what great Success it was attended; and then whole Families came into it, and underwent the Operation. There were in all at least 280 Persons inoculated, that I knew of, and I suppose there might be about 20 or 30 more, but of those I can give no certain Account.

*John Osborne.*

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\* *The Reverend Mr. Walter.*